

# The water-food-energy nexus

## The water-food-energy nexus in the WANA region

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The nexus refers to the connection between the water, food and energy sectors. It is an approach used to understand dependencies: one nexus element cannot exist without the other, and changes to one will impact another. The water-energy-food nexus is highly complex and various processes of human activity are related to all sectors. While sectors have previously been dealt with in isolation, a nexus approach can increase water, energy and food security by increasing efficiencies of production systems, reducing trade-offs, building synergies and improving governance<sup>1</sup>.

A nexus approach can help identify externalities in production systems across sectors, such as the energy intensity of desalination. This is particularly important in the West Asia – North Africa (WANA) region because of scarce agricultural land and water resources and high potential for energy production. Being the most limiting factor for economic development, water plays a central role, which other sectors have to be aligned to. Compared to food, it cannot be traded or transported easily and compared to energy, it is scarce. Depending on its use, water is often associated with high opportunity costs, particularly in irrigated agriculture.

### The nexus components

Water is needed to generate energy for processes including extraction, refining, and cooling and energy is needed for water supply. The same interdependency applies to water and food. Water is needed to produce food and the water used for its production is embedded in that food. Food trade therefore virtually transports the water used during the production processes. Energy and food have a similar relationship: food production and supply lines require energy and energy can potentially be generated from food.

The water-food-energy nexus in the WANA region is characterised by extremes in these three sectors: the lowest water availability (1.4% of global supplies), the highest global food import dependency (more than half of consumed cereals and calories are imported) and at 66% of global supplies, the biggest known fossil energy reserves. Because of low, seasonal and uncertain rainfall and heavy reliance on groundwater and desalination in large parts of the region, the production of staple foods and domestic and industrial water supply are associated with energy-intensive water infrastructure<sup>2</sup>.

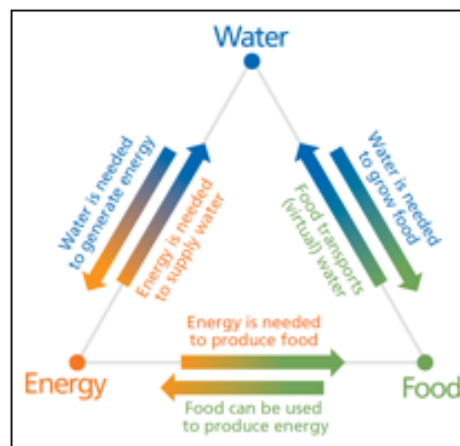


Figure 1: UNU (2013). Water Security and the Global Water Agenda.

### Water and energy

The WANA region's water-energy nexus is highly skewed. A weak dependency of the energy sector - mostly gas and oil - on water is contrasted with a very strong dependency of the water sector on energy for extraction, delivery, use and disposal. Particularly urban piping systems are vulnerable to failures in energy supply, which result

in the failure of water infrastructure. Water desalination and conveyance are among the most energy consuming processes in the region. Wastewater treatment, however, consumes a lot less energy than desalination.

Most water consumption in energy production is related to cooling in power plants, refining and electricity generation. Energy subsidies are generally high in the region, which often leads to overuse and mismanagement of both water and energy<sup>3</sup>.

### Agriculture and energy

Modern agriculture is very energy intensive, which is related to chemical inputs, machinery and off-farm processes. The increasing energy demand is also related to climatic changes, such as decreased rainfall and higher temperatures. Elevated crop water requirements (the water needed to produce a unit of harvested crop) result in higher aquifer pumping and in some cases desalination rates. Industrial agriculture, thus, has its own contribution to processes of climate change, as most energy for the sector is fossil fuel-based<sup>4</sup>.

Producing energy from food is not an option for the WANA region, as the import rate of food is already high, energy supply is relatively cheap and agricultural land is relatively scarce. Domestically produced food is often related to energy-intensive water infrastructure. At the same time, agricultural production and related energy are subsidised, which again leads to inadequate use of these resources.

### Water and agriculture

Countries in the region use up to 90% of their water

<sup>1</sup> Hoff, H., Understanding the Nexus. Background Paper for the Bonn2011 Conference: The Water, Energy and Food Security Nexus. Stockholm Environment Institute, Stockholm, 2013

<sup>2</sup> Siddiqi, A, Diaz Anadon, L., The water-energy nexus in Middle East

and North Africa, Energy Policy 39 (2011) 4529–4540, Elsevier, 2011

<sup>3</sup> Ibid..

<sup>4</sup> WBCSD, Water, food and energy nexus challenges - Business solutions for a sustainable world, 2014

resources for agricultural production, while only about 45% of the region's area is agricultural land and the bulk of this is pasture<sup>5</sup>. Often, existing farming systems are water-inefficient and lack innovative improvement, while the types of crops are often water-intensive and realise low market prices.

Subsidies for water and agricultural products again have negative effects on resource use, such as over-irrigation. Surprisingly - and as a result of these subsidies - some countries still produce high water consuming food for export to the region<sup>6</sup>.

### Closing loops, increasing efficiency

The importance and complexity of the nexus approach for the WANA region can be depicted when following water resources in successive stages and uses. Generally speaking, the nexus approach attempts to find solutions for the challenge of achieving more with less input. Synergies and resource cycles are important elements in this approach. When tracing water, different uses and quality needs determine the cyclic order: growth in population requires the equivalent amount and standard of additional freshwater needs for drinking and household use. Effluents can be used in industries as grey water (from cleaning, showering etc.) in many processes with little or no treatment and industrial effluents can be recycled or, together with properly processed human waste from black water, be used in agriculture. These treatments and industrial processes create thermal heat that can again be used for other purposes.

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### The importance of the nexus approach to a green economy

The major factors making the nexus approach important for the WANA region are

- that water in WANA is scarce and yet significant amounts are used in every sector,
- the kinds of energy used in the region are not climate-friendly,
- the agricultural sector is currently very water- and non-renewable energy-intensive.

Governments, businesses, NGO initiatives and other stakeholders can use the nexus approach to develop integrated approaches that address sectors (incl. climate change) as one system. This is what leads to better efficiencies in all sectors. The energy sector is a key component for ensuring regional security. Fossil and renewable energies will continue to be the dominating component of the nexus to build secure water and food systems.

### Future challenges

In a highly globalised economy, the opportunities provided by easing pressures on local resources and financial gain from trade in energy and food come with increasing dependence on other regions.

However, the rising energy demands and decreasing

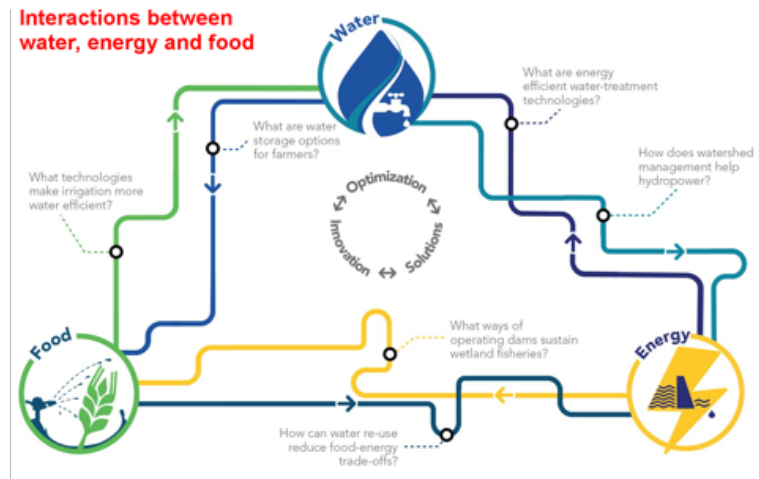


Figure 2: IUCN IWA Nexus Dialogue

availability of water (total and per capita) represent the biggest challenge for the WANA region. Population growth is among the highest in the world and demands will grow even faster due to changing lifestyles. Demand management in all three components of the nexus will be an important adaptation measure, as current behaviours - fuelled by government subsidies in many cases - create waste of water, energy and food. The reuse of wastewater is low, although mostly cheaper than accessing new water resources. Lifting subsidies while protecting the poor and middle class will thus have a positive effect on resource use and on incentivising economic change.

### About the author

Sebastian holds a B.A. in Geography and Political Science and a M.Sc. in Integrated Water Resources Management. He had further education in Permaculture and Agroforestry system design. His interests lie in application and research of land use systems, sustainable community life and socio-economic, political and cultural dimensions of water management. A special interest in the West Asia - North Africa region is based on its traditional land use systems and vast cultural heritage.

<sup>5</sup> FAOSTAT.

<sup>6</sup> Sullivan, The Water-Energy-Food Conflict Nexus in MENA, 2013.